ELECTRICITY GENERATION THROUGH STIMULUS-RESPONSIVE SMART LOCOMOTIONS OF FUNCTIONALLY COOPERATING SYSTEMS

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Inspired by various bio-motors, the research on self-propulsion strategies has gained increasing attention and gradually focuses on possible applications, such as directed transportation, drug delivery, bio-mimicking, separation of special cargo, manipulation of cells, and macroscopic supramolecular assembly etc. Among them, electricity generation based on the Faraday's law of electricity induction has been an advanced progress, which converted mechanical motions to electricity through self-propulsion strategies. In this aspect, we have developed functionally cooperative smart systems with cyclic diving-surfacing motions for electricity generation when exposed to magnetic field (Figure 1). Besides, mini-generators based on the Pt-H2O2 reaction or the CaCO3-HCl reaction were developed to either improve the motion efficiency or introduce bubble systems non-hazardous to smart surfaces, respectively. To handle the challenge of improving energy conversion efficiency, we learned from the working mechanism of the swim bladder by only consuming the inner energy of bubbles instead of indirectly using chemical reactions. We fabricated a smart device made of a 3D printed model fish with a superhydrophobic surface and realized diving/surfacing motions of by directly consuming the inner energy of bubbles, thus leading to improved energy conversion efficiency by 10-fold compared with previous results. When the buoyancy driven diving-surfacing motions were carried out in magnetic field by cutting the magnetic lines repeatedly, we achieved electricity generation with the as-prepared smart device, which worked as a mini-generator. Moreover, the applied ambient pressure is close to the range of human blood pressure, indicating possible application of in situ mini generator to solve the power supply problem such as for cardiac pacemaker implanted in human body.

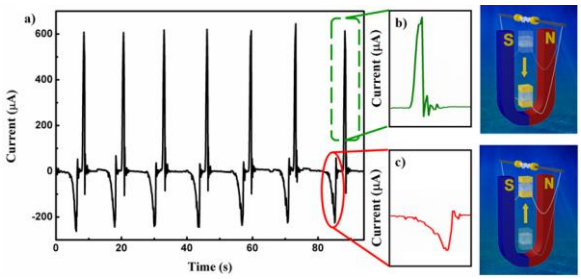

Fig. 1 Electricity generation through smart diving/surfacing motions.

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